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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/663,948	09/16/2003	Rajesh Tiwari	TI-36211	3857
23494	7590	09/09/2005	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED P O BOX 655474, M/S 3999 DALLAS, TX 75265			CAO, PHAT X	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 09/09/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H-P

Office Action Summary

Application No.

10/663,948

Applicant(s)

TIWARI ET AL.

Examiner

Phat X. Cao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 June 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 2 and 4-9 is/are pending in the application.
- 4a) Of the above claim(s) 5-8 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-2, 4, 9 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. The cancellation of claim 3 in Paper filed on 6/20/05 is acknowledged.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-2, 4 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shimizu (US. 6,433,432) in view of Watanabe et al (US. 2003/0227089).

Regarding claims 1 and 2, Shimizu (Figs. 3H-3K) discloses a method of forming a copper interconnect layer, comprising: forming a first copper region 10 (column 4, lines 54-56) over a semiconductor substrate 1; forming a low K dielectric layer 12 (column 5, lines 27-30 and column 1, lines 16-21) over the copper region 10; forming a plurality of vias 12a in a first region of the low K dielectric layer 12; forming a trench 16 with a first edge 13 in the low K dielectric layer 12 over the plurality of vias, wherein the trench 16 extends a minimum length 12b beyond the edge of a via 12a closest to the first edge of the trench; and filling the trench 16 and the plurality of vias with copper 14 (column 5, lines 60-62). Shimizu's Fig. 3J further discloses that the trench 16 is formed with a first depth d1 in the first region and a second depth d2 at the trench edge 12b when d1 is greater than d2.

Shimizu does not disclose that the minimum length 12b extending beyond the edge of the via 12a is 0.2 um.

However, Shimizu does disclose that the trench 16 extends a minimum length 12b beyond the edge of the via 12a closest to the first edge of the trench 16 (Fig. 3J), the edges of the via 12a are obliquely scraped off to expand a diameter of the via 12a in the neighborhood of the trench 16 (column 5, lines 45-51) for participating in preventing the peeling-off of the plugs from the metal wirings (column 6, lines 13-19). Furthermore, Watanabe (Figs. 24B-24C) teaches a forming of a copper interconnect structure comprising a trench 603 formed over a plurality of vias 602, the trench 603 extends a length of 0.4 μm beyond the edge of the via 602 (par. [0175]). Accordingly, it would have been obvious to extend the length 12b of the trench beyond the edge of the via 12a closest to the first edge of the trench with a minimum length as claimed (as suggested by Watanabe) because such minimum length would provide the same effects of preventing the peeling-off of the plugs from the metal wiring.

Regarding claims 4 and 9, as discussed in details above, the combination of Shimizu and Watanabe substantially reads on the invention as claimed. Watanabe (Figs. 24B-24C) further teaches that the plurality of vias 602 are separated by a distance of 0.6 μm (par. [0175]). Accordingly, it would have been obvious to separate the plurality of vias of Shimizu with a distance as set forth above because such distance is not critical, it can be adjusted depending upon the width desired for the wiring patterns, as taught by Watanabe (par. [0175]).

Response to Arguments

3. Applicant argues that the trench extension 12b of the trench 16 of Shimizu does not participate in preventing the peeling-off of the plugs from the metal wirings.

This argument is not persuasive because of the following reasons:

first, Shimizu clearly discloses that the structure as a whole for preventing the peeling-off of the plugs from the metal wirings (column 6, lines 13-19) includes the step of removing the oxide film formed on the surface of the copper wiring 10 and the step of obliquely scraping off the edge of the via 12a to expand a diameter of the via 12a in the neighborhood of the trench extension (Fig. 3I and column 5, lines 45-51);

and second, it is noted that when the structure recited in the reference is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent. *In re Best*, 195 USPQ 430, 433 (CCPA 1977). In this case, as asserted by Applicant, the peeling-off of the plugs from the metal wirings results from the trench termination overhang Xto (see Applicant's Fig. 2C), the trench termination overhang Xto includes a first trench depth d1, a second trench depth d2 and a transition trench depth d3, where d2, d3, d1 (pages 7-8 of Applicant's specification). Similarly, Shimizu also discloses a copper interconnect structure having a trench termination overhang 12b (Fig. 3I), the trench termination overhang 12b includes a first trench depth d1, a second trench depth d2 and a transition trench depth d3 (corresponding to scrap-off portion between the edge of the via 12a and the edge of the trench 16). Therefore, because the trench termination overhang of Applicant is not different from the trench termination overhang of Shimizu, the trench termination overhang 12b of Shimizu would have the same properties of preventing the peeling-off of the plugs from the metal wirings.

Applicant further argues that the applied prior art does not suggest the minimum trench extension of 0.2 μm beyond the edge of a via.

This argument is not persuasive because Watanabe (Figs. 24b-24c) teaches a forming of a copper interconnect structure comprising a trench 603 formed over a plurality of vias 602, the trench 603 extends a length of 0.4 μm beyond the edge of the via 602 closest to the first edge of the trench (par. [0175]). Furthermore, there is nothing in the Applicant specification, which supports that the peeling-off of the plugs from the metal wirings will not result for the trench extension overhang less than 0.2 μm beyond the edge of a via. It appears that the peeling-off of the plugs from the metal wirings would be prevented for any lengths of the trench extension overhang. It should be noted that "the law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims ... In such a situation, the Applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F. 2d 1575, 16 USPQ 2d 1934 (Fed. Cir. 1990).

Conclusion

4. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phat X. Cao whose telephone number is 571-272-1703. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PC
September 2, 2005


PHAT X. CAO
PRIMARY EXAMINER